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Spillover Effects of the Robinson Scholars Program in the Service Area

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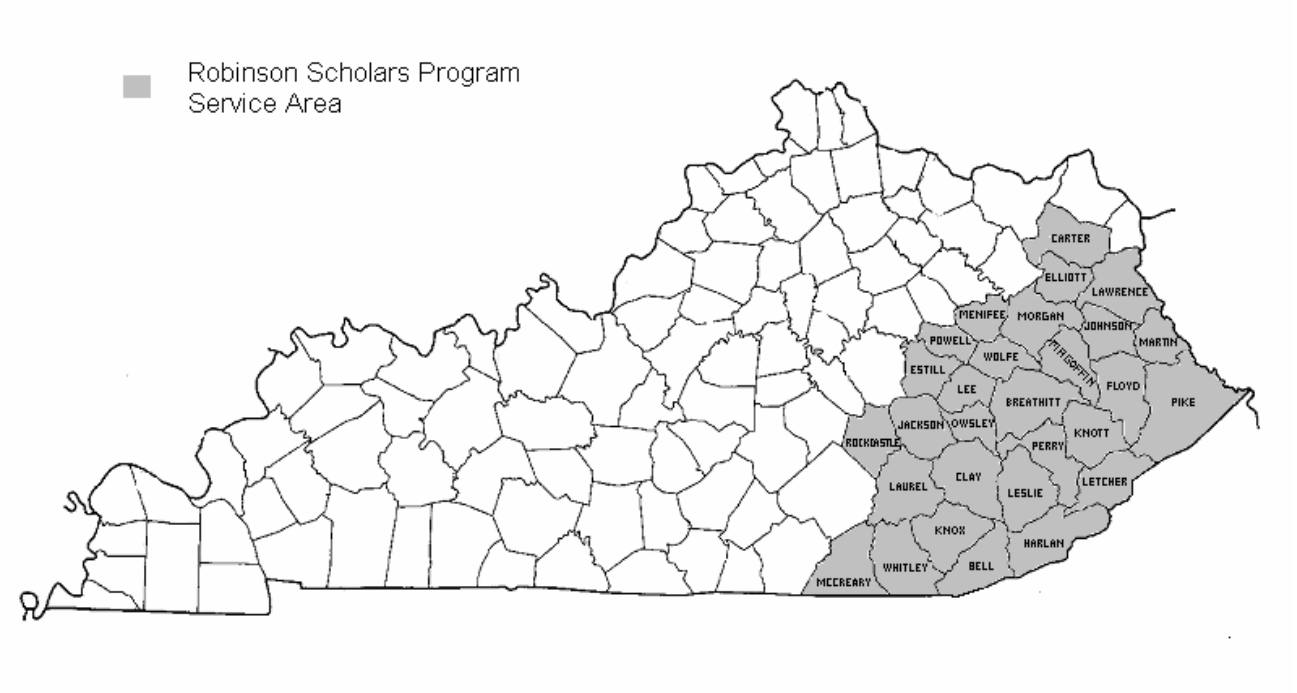

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Executive Summary

High rates of poverty and low levels of educational attainment have plagued the Appalachian region throughout history. The Robinson Scholars Program was created in 1996 as part of the University of Kentucky Board of Trustees' plan to support economic and community development in Appalachian Kentucky.

The Robinson Scholars Program is a scholarship and student support program that serves first-generation college and college-bound students from twenty-nine Eastern Kentucky counties with historically low rates of college attendance. The Program's mission is to empower students to complete baccalaureate degrees and thereby add to the educational capital of their communities. The first class of Robinson Scholars was selected as eighth-graders in 1997. Since its inception, the Program has named approximately 540 students as Robinson Scholars.

The Robinson Scholars Program likely affects not only the Scholars themselves, but also their families and communities. The visibility of Robinson Scholars in their communities, including those who have graduated from the University of Kentucky and returned to the area to pursue their careers, may inspire others in the community to pursue higher education as well. The purpose of this study is to investigate this phenomenon by collecting and analyzing empirical data to determine if such a "peer effect" or "role model effect" does, in fact, exist. The existence of an effect will highlight indirect and unintended benefits of the Program in addition to the benefits enjoyed by the Scholars themselves. The following research questions were explored:

- Did implementation of the Robinson Scholars Program have the effect of increasing high school graduation rates in the 29-county service area?

- Did implementation of the Robinson Scholars Program have the effect of increasing college matriculation rates in the 29-county service area?

To answer these questions, a panel data set for 171 of Kentucky's 176 school districts was used first to estimate two simple linear regression models and then to estimate two fixed effects models. The dependent variables in the models were district high school graduation rate and college matriculation rate in school year t, for t from 1994-1995 to 2004-2005. The fixed effects models were determined to be preferred to the simple linear regression models.

The results of the fixed effects models show no statistically significant effect of the Robinson Scholars Program on high school graduation and college matriculation rates in the service area. Though there is no evidence that the Program is having an effect, the results suggest that the model estimation could be improved by using individual level data. Such a data set could potentially control for omitted variables, which may be biasing the coefficients of the models presented here.

Background

Throughout history, high rates of poverty and low levels of educational attainment have plagued Appalachian Kentucky. Twenty-nine percent of households in the area have incomes below the poverty level, compared to 16% of households statewide and 12% nationwide. Only 9% of adults in the area have bachelor's degrees or higher, compared to 17% of adults statewide and 24% nationwide. (Census 2000)

According to the Kentucky Department of Education, 75% of high school students in the area graduated in 2003, compared to 79% of high-schoolers statewide.[1] Of those who graduated high school, only 50% enrolled at a 4-year post-secondary institution in the fall following their senior year, compared to 55% of students statewide and 64% nationwide[2].

To counter these disparities, the University of Kentucky Board of Trustees adopted a plan in 1991 that set aside coal and timber royalties from a 5,000-acre section of Robinson Forest to support economic and community development efforts in Appalachian Kentucky. A significant portion of the funds was allocated to provide college scholarships to students from 29 Eastern Kentucky counties with historically low rates of college attendance. Thus, in 1996, the Robinson Scholars Program was born. The Program's mission is to empower students to complete baccalaureate degrees and thereby add to the educational capital of their communities. The first class of Robinson Scholars was selected as eighth-graders in 1997. As hoped, many Robinson Scholars

[1] National data on high school graduation rates is not included due to possible differences in measurement by other sources. KDE does not report national graduation rates in their data sets, and there is no way to be certain that similar statistics from another source would be calculated the same way.
[2] Census 2000

Program alumni have returned to their communities upon graduation from the University of Kentucky to pursue their careers.

The Robinson Scholars Program

The Robinson Scholars Program is a scholarship and student support program that serves first-generation college and college-bound students who have demonstrated the potential to succeed but who might encounter economic, cultural, or institutional impediments to their completion of a four-year degree. The Program defines first-generation college students as those whose parents and grandparents have not obtained a bachelor degree or higher at the time of selection. The service area includes 29 counties in Eastern Kentucky with historically low rates of college attendance. Students are selected in the eighth grade and receive support services and college preparation throughout high school. Upon matriculation at either the University of Kentucky or a KCTCS institution, the students receive scholarships and support services at the college level (see www.uky.edu/RobinsonScholars).

The first group of Robinson Scholars was selected in 1997 as eighth-graders. Those that remained active in the Program throughout high school matriculated at either the University of Kentucky or a KCTCS institution in the fall of 2001. A new class of Scholars has been selected each year since 1997, and the Program will select its eleventh class of 29 Scholars from over 700 applicants in May 2007. Since its inception, the Program has named approximately 540 students as Robinson Scholars.[1] To date, 21 Scholars have obtained an associate's degree, 72 Scholars have graduated from the

[1] Since 2000, Robinson Scholars' cohorts have consisted of 29 students, one student from each of the 29 counties served. The first, second and third cohorts consisted of 162, 116, and 57 Scholars respectively.

University of Kentucky with a bachelor's degree, and 27 of those with a bachelor's degree have gone on to pursue graduate degrees. The Program expects that 40 more Scholars will graduate with a bachelor's degree in May 2007. Program-wide 4-year graduation rates for the first two cohorts of Scholars are 21.01% and 22.45% respectively. The Program-wide 5-year graduation rate for the first cohort of Scholars is 34.78%.[1]

Research Questions

The Robinson Scholars Program likely affects not only the Scholars themselves, but also their families and communities. It is possible that the presence of Robinson Scholars in their schools and knowledge of the Program in the community have caused the Scholars' peers to consider pursuing higher education as well. Students see their fellow classmates choosing college preparatory classes, taking the ACT, and applying to college. Conversations about going to college occur between Scholars and their peers as well as between the Scholars' parents and their peers' parents. In short, the visibility of Robinson Scholars in their communities, including those who have graduated from the University of Kentucky and returned to the area to pursue their careers, may inspire others in the community to pursue higher education as well.

The purpose of this study is to investigate this phenomenon by collecting and analyzing empirical data to determine if such a "peer effect" or "role model effect" does,

[1] "Program-wide" graduation rates are calculated as the number of Scholars graduating with baccalaureate degrees divided by the number of Scholars who initially matriculated at any eligible institution (UK or KCTCS) in the fall following their senior year of high school. The 4-year graduation rates for those Scholars who initially matriculate at UK are significantly higher—33.33% for the first cohort of Scholars (compared to 30.00% for that cohort's UK counterpart) and 31.67% for the second cohort of Scholars. The 5-year graduation rate for the first cohort of Scholars initially matriculating at UK is 50.00%.

in fact, exist. The existence of an effect will highlight indirect and unintended benefits of the Program in addition to the benefits enjoyed by the Scholars themselves. The following research questions will be explored:

- Did implementation of the Robinson Scholars Program have the effect of increasing high school graduation rates in the 29-county service area?
- Did implementation of the Robinson Scholars Program have the effect of increasing college matriculation rates in the 29-county service area?

Literature Review

Peer Effects on Educational Achievement in High School

One can expect that a student's peers have an effect on his or her educational achievement. Peers can either directly influence achievement (i.e. through studying together) or do so indirectly (i.e. through values), with the latter seeming to be more likely (Robertson and Symons, 2003). The educational "peer effect" literature began with the Coleman Report in 1966. While the early literature on peer effects focused on the influence that racial composition of schools and classrooms had on educational achievement, recent literature has focused on ability (see Zimmer and Toma, 2000 for a detailed review of the literature). This body of literature establishes peer effects as an important part of the educational production function presented by Hanushek (1992), where educational achievement (as measured by, for example, standardized test scores or graduation from high school) at time t (A_t) is a function of family inputs (F_t), school inputs (S_t), peer effects (P_t), and previous educational achievement at time $t - 1$ (A_{t-1}):

$$A_t = \varphi(F_t, S_t, P_t, A_{t-1}).$$

Zimmer and Toma (2000) find significant peer effects using international data. They show that high ability students exert a positive peer effect on their low ability counterparts, and that this positive effect is greater than the negative effect the low ability students have on their high ability counterparts.

Other important factors in the educational production function are family inputs and school inputs. There is substantial agreement in the literature that socioeconomic characteristics and other family inputs are important factors in predicting student achievement (Haveman and Wolfe, 1995; Hanushek, 1986). There is little evidence that school inputs such as per-pupil expenditures and student-to-teacher ratios matter for educational achievement (Hanushek, 1986), though Card and Krueger (1992) recently challenged this generally accepted view. They find a significant correlation between returns to schooling in the United States and school quality as measured by traditional school inputs such as those described above.

Several studies have been conducted that attempt to estimate educational production functions using aggregate rather than individual data. A great number of such studies measure the dependent variable, educational achievement, using average standardized test scores (i.e. Kiesling, 1967; Brown and Saks, 1975; Sebold and Dato, 1981). Dee (1998) measures educational achievement using the district-level high school graduation rate, which he calculates using dropout data by school district and by grade for 18 states that use a consistent definition for dropouts. The data he uses are drawn from the National Center for Educational Statistics' (NCES) Common Core of Data. His study examines the relationship between public school quality and competition from

private schools, though the model he uses provides insight into other determinants of high school graduation. Dee (1998) controls for socioeconomic characteristics of the school district such as the percentage of students that are non-white, the educational attainment of the adult population, and the median income of households with children. He also includes a school variable, per-pupil expenditures.

Peer Effects on the Decision to Enroll in College

Becker's (1962) model of the decision to invest in higher education is based on the traditional economic perspective. One's decision to enroll in college is influenced by expected costs and benefits, financial resources, academic ability, current and expected labor market opportunities, personal preferences and tastes, and uncertainty. Perna (2000) expands upon the traditional model by including measures of social and cultural capital. She points to a body of literature, from the field of sociology, that studies the effect of peers on the decision to enroll in college, where peer effects are measured by peers' college plans and behaviors (Alexander, Eckland, and Griffin, 1975; Alwin and Otto, 1977) and peer encouragement for college enrollment (Jackson, 1990). Alexander, Eckland, and Griffin (1975) and Alwin and Otto (1977) find that peer effects are an important, though indirect, component of college aspirations. Jackson (1990) finds a positive and significant relationship between peers' desire for the respondent to go to college and the likelihood of college entry. Perna (2000), however, finds that peer inputs do not matter for any of the three groups (blacks, Hispanics, and whites) in her study.

The Socialization/Role Model Perspective from the fields of sociology and developmental psychology also contributes to the present analysis. Haveman and Wolfe

(1995) point to this model as contributing to the economics literature on educational achievement. Role models are defined as "adults or peers to whom children or adolescents relate and who set norms of behavior and achievement to which they aspire," (Haveman and Wolfe, 1995:1834). Nixon and Robinson (1999) present evidence of the existence of a role model effect of female high school faculty on the educational attainment of young women. For the purpose of this study, the role model effect is that of students with post-secondary plans acting as role models for their peers, thus encouraging them to aspire to education beyond high school as well.

Data and Methodology

Data

Panel data for the 1994-1995 to 2004-2005 school years was obtained for 171 of Kentucky's 176 school districts[1], resulting in 1,881 observations. Two dependent variables were included in this study, the district high school graduation rate and college matriculation rate. Each district's high school graduation rate was calculated using data from the NCES Common Core of Data (CCD).[2] Though seemingly straightforward, there is some debate about how to calculate high school graduation rates accurately. Swanson and Chaplin (2003) discuss four alternative calculations and the advantages and disadvantages of each. The current study uses the Greene method developed in Greene (2002a, 2002b) and presented in Swanson and Chaplin (2003)[3]:

[1] Data for five districts was excluded because there are not high schools in those districts.
[2] High School graduation rate data was unavailable for the 2004-2005 school year, and was therefore not included in the analysis.
[3] The use of alternative measures of graduation rates is a possibility for future research. The Greene Method was chosen based on available data.

$$GreeneRate = \frac{R_{1999}}{E^{9}_{1996} + \left(E^{9}_{1996} * \frac{E^{9\text{-}12}_{1999} - E^{9\text{-}12}_{1996}}{E^{9\text{-}12}_{1996}}\right)}$$

where

R_{1999} is the count of regular high school diploma recipients for the 1999-2000 school year;

E^{9}_{1996} is the size of the 9th grade cohort in 1996-1997;

$E^{9\text{-}12}_{1999}$ is the count of students enrolled in grades 9-12 in the 1999-2000 school year; and

$E^{9\text{-}12}_{1996}$ is the count of students enrolled in grades 9-12 in the 1996-1997 school year.

Matriculation rate data was obtained from the Kentucky Department of Education's (KDE) Nonacademic Data Set. Students matriculating at an in-state or out-of-state four-year institution were included. It is worth mentioning that the matriculation data reported by the KDE may not be reliable given the way the data is collected. The reported rates are based on data collected in the spring by surveying seniors about their post-secondary plans. By the fall, students who were counted as non-matriculants may have enrolled at a post-secondary institution after all. The opposite scenario may also be true. That is, students who were counted as matriculants may have failed to enroll at all or enrolled in a two-year institution instead. Though not perfect, these are the rates reported by the state of Kentucky and are the only available measures of college matriculation for Kentucky's school districts. Any errors in the reported matriculation data are assumed to be randomly distributed across school districts. It is reasonable to

assume that no school district's reported rate is systematically biased upward or downward.

The variable of interest in both the high school graduation and college matriculation models is the existence of the Robinson Scholars Program. As discussed previously, the first class of Robinson Scholars was selected in the spring of 1997. This cohort graduated high school and matriculated at a college or university in the fall of 2001. The implementation of the Kentucky Educational Excellence Scholarship (KEES), which was enacted in 1998 and first awarded in the 1999-2000 school year, is included as a control, as it seems likely that its implementation affected high school graduation and college matriculation rates. The KEES variable is measured using data from the Kentucky Higher Education Assistance Authority (KHEAA). It is defined as the percentage of 12^{th} graders in district *i* that receive a bonus award[1] in year *t*. This measure also acts as a proxy for ability in the school district due to unavailability of traditional ability measures.[2]

Data for the control variables for the relevant time period was obtained from various sources, which include the CCD, the 2000 U.S. Census, the Current Population Survey (CPS), and the Southern Regional Education Board's (SREB) Data Library. Socioeconomic characteristics of the school districts are included as controls for both models and include race, adult education level, income, poverty, and the degree of urbanicity in the school district. Per-pupil expenditures are included as a control in the

[1] Bonus awards are given based on a student's ACT score.
[2] Data typically used to measure ability, standardized test scores, was not available for the relevant time period.

high school graduation model representing school inputs. Labor market inputs (expected future income and the unemployment rate) and cost of college attendance (tuition and financial aid) are included as controls in the college matriculation model.

Dee (1998) presents evidence from Lankford and Wyckoff (1992) that there is some ambiguity in interpreting results using aggregate data. For example, the level of income may reflect either the wealth of an individual student's family or that of her peers. As discussed above, however, many researchers have used aggregate data to examine education production functions. Lillard and DeCicca (2001) use both aggregate and individual data to investigate whether state course graduation requirements affect the decision to drop out of high school. They find that the results of the individual data are consistent with those of the aggregate data. Using individual level data to determine the effect of the Robinson Scholars Program on high school graduation and college matriculation in the service area is an area for future research.

Table 1 defines and lists data sources for the dependent and explanatory variables in the high school graduation model. The selection of control variables in the high school graduation model follows those used by Dee (1998), who also models high school graduation rates using aggregate data. Table 2 defines and lists data sources for the dependent and explanatory variables in the college matriculation model. Controls in the college matriculation model are based on the model presented in Perna (2000), which examines the decision to enroll in college.

TABLE 1: Model of High School Graduation Rate, Variable Definitions and Data Sources

Variable	Label	Definition	Source
Dependent Variable			
High School Graduation Rate	hsgradrate	High school graduation rate in district *i* in year *t* (includes only those receiving a high school diploma)	NCES CCD
Explanatory Variables			
Robinson Scholars Program	rsp	Robinson Scholars Program exists in year *t* = 1, otherwise = 0	RSP website
KEES Program	kees	Percentage of 12th graders in district *i* that receive a bonus award in year *t*	KHEAA
%Non-white high schoolers[1]	nonwhite	%Non-white high schoolers in district *i* in year *t*	NCES CCD
%Adult Population HS or Some College	adult_hs_or_sc	%Adult population (25 years+) in district *i* in the year 2000 with high school degree or some college	Census 2000 data reported by NCES
%Adult Population College Degree	adult_coll	%Adult population (25 years+) in district *i* in the year 2000 with at least a bachelor degree	Census 2000 data reported by NCES
Median Family Income	med_inc000	Median family income in district *i* in the year 2000 (in thousands)	Census 2000 data reported by NCES
%Rural in county or city	rural	%Rural population in county or city in which school district *i* is located in the year 2000	Census 2000
Per pupil expenditures[2]	ppe000	Instructional expenditures per pupil in district *i* in year *t* (in constant 2005 thousands of dollars)	NCES CCD

[1] Values for the 1994-1995 to 1997-1998 school years were imputed using available data from the 1998-1999 to 2004-2005 school years.
[2] Values for the 2004-2005 school year were imputed using available data from the 1994-1995 to 2003-2004 school years.

TABLE 2: Model of College Matriculation Rate, Variable Definitions and Data Sources

Variable	Label	Definition	Source
Dependent Variable			
College Matriculation Rate	coll_rate	Matriculation rate at a 4-year college or university in district *i* in year *t*	KDE Nonacademic Data Set
Explanatory Variables			
Robinson Scholars Program	rsp	Robinson Scholars Program exists in year *t* = 1, otherwise = 0	Robinson Scholars Program website
KEES Program	kees	Percentage of 12th graders in district *i* that receive a bonus award in year *t*	KHEAA
%Non-white high schoolers[1]	nonwhite	%Non-white high schoolers in district *i* in year *t*	NCES CCD
%Adult Population HS or Some College	adult_hs_or_sc	%Adult population (25 years and over) in district *i* in the year 2000 with high school degree or some college	Census 2000 data reported by NCES
%Adult Population College Degree	adult_coll	%Adult population (25 years and over) in district *i* in the year 2000 with at least a bachelor degree	Census 2000 data reported by NCES
Median Family Income	med_inc000	Median family income in district *i* in the year 2000 (in thousands)	Census 2000 data reported by NCES
%Rural in county	rural	%Rural population in county or city in which school district *i* is located in the year 2000	Census 2000
Expected Future Income	exp_fut_inc000	Difference in average earnings for individuals nationwide over age 25 with a bachelor's degree and a HS diploma in year *t* (in constant 2005 thousands of dollars)	CPS
Unemployment Rate	unemp_rate	County unemployment rate in year *t*	CPS
Median cost of Tuition	med_tuition000	Median cost of tuition at public 4-year colleges and universities in KY in year *t* (in constant 2005 thousands of dollars)	SREB Data Library
Average Financial Aid Award	avg_aid000	Average amount of financial aid per student in KY in year *t* (in constant 2005 thousands of dollars); includes state aid, Pell grants, loans, and work-study	SREB Data Library

[1] Values for the 1994-1995 to 1997-1998 school years were imputed using available data from the 1998-1999 to 2004-2005 school years.

Summary statistics are reported in Table 3. It is interesting to note the range of high school graduation rates in the data set. The minimum value of the high school graduation rate variable is 12.5%, which is extremely low and likely not a true graduation rate for a district. Also, several of the calculated rates had to be eliminated from the data set due to the fact that they were greater than 100%.[1] These points highlight the inherent problems in calculating high school graduation rates, and suggest that testing other methods of calculation is desirable. These errors, however, are assumed to be randomly distributed across the school districts with no systematic bias in either direction.

There are several other interesting statistics reported in Table 3. First, the maximum college matriculation rate is extremely high, 94.6%. This matriculation rate is observed for an independent school district. High matriculation rates are more typical for independent school districts in Kentucky. The average matriculation rate in independent districts is 58.14%, compared to 47.08% in the rest of the state. Another interesting statistic is the maximum for the KEES variable, 100%. This statistic is interpreted as follows: 100% of the twelfth graders in a given year in a given district received a KEES bonus award. Upon inspection of the data, this observation is for an independent school district with very small enrollment (16). The minimum value for the KEES variable, zero, reflects the fact that the program was not implemented until the 1998-1999 school year. Therefore, the variable's value is zero for the 1994-1995 to 1997-1998 school years.

[1] This deletion did not eliminate any districts entirely from the data set. Twenty-two total observations were omitted for this reason, with no district having more than two out of its eleven years of observations omitted.

TABLE 3: Summary Statistics

Variable	N	Mean	SD	Minimum	Maximum
hsgradrate	1688	0.697	0.1084	0.125	0.999
coll_rate	1881	0.504	0.1352	0.160	0.946
rsp	1881	0.170	0.3758	0	1
kees	1877	0.338	0.2799	0	1.000
nonwhite	1880	0.069	0.0932	0.000	1.000
adult_hs_or_sc	1881	0.478	0.0735	0.282	0.632
adult_coll	1881	0.154	0.0866	0.054	0.528
med_inc000	1881	36.684	9.8879	18.034	70.495
rural	1881	0.568	0.3826	0.000	1.000
ppe000	1881	6.582	0.7372	4.474	10.717
exp_fut_inc000	1881	23.411	2.5274	18.932	26.543
unemp_rate	1881	0.062	0.0233	0.016	0.258
med_tuition000	1881	2.987	0.5727	2.385	4.301
avg_aid000	1881	4.970	0.8821	3.877	6.821

Methodology

The use of panel data in this study has several advantages. First, it provides a larger number of observations since each school district is observed repeatedly. Second, it allows the model estimation to control for unobserved, idiosyncratic factors associated with each school district through the use of school district fixed effects. One frequently cited disadvantage of fixed effects models is the loss of explanatory variables which do not vary over time for each unit of analysis (here, a given school district). The effects of these variables can be recovered, however, through the use of the between estimator.

First, a simple linear regression model for each dependent variable was estimated using OLS. These models do not incorporate fixed effects. Using simple linear

regression with no fixed effects does not control for the unobserved or unmeasurable characteristics of the school districts. This method can produce vastly different results than a model that incorporates school district fixed effects. If, for example, the unobserved or unmeasurable school district effects are significant and positively correlated with the measured effects, then the results using simple linear regression are biased upward. In other words, policy impacts may be overstated in this case.

The simple linear regression models have the following form:

$$(\text{hsgradrate})_{it} = \beta_0 + \beta_1*(\text{rsp})_{it} + \beta_2*(\text{kees})_{it} + \beta_3*(\text{nonwhite})_{it} + \beta_4*(\text{adult\_hs\_or\_sc})_i + \beta_5*(\text{adult\_coll})_i + \beta_6*(\text{med\_inc000})_i + \beta_7*(\text{rural})_i + \beta_8*(\text{ppe000})_{it} + \varepsilon_{it}$$

$$(\text{coll\_rate})_{it} = \beta_0 + \beta_1*(\text{rsp})_{it} + \beta_2*(\text{kees})_{it} + \beta_3*(\text{nonwhite})_{it} + \beta_4*(\text{adult\_hs\_or\_sc})_i + \beta_5*(\text{adult\_coll})_i + \beta_6*(\text{med\_inc000})_i + \beta_7*(\text{rural})_i + \beta_8*(\text{unemp\_rate})_{it} + \beta_9*(\text{exp\_fut\_inc000})_t + \beta_{10}*(\text{med\_tuition000})_t + \beta_{11}*(\text{avg\_aid000})_t + \varepsilon_{it,}$$

where *i* is a given school district, *t* is the year, and ε is the error term.

Next, the two models were estimated using school district fixed effects. The following two fixed effect models were estimated:

$$(\text{hsgradrate})_{it} = \beta_0 + \beta_1*(\text{rsp})_{it} + \beta_2*(\text{kees})_{it} + \beta_3*(\text{nonwhite})_{it} + \beta_4*(\text{adult\_hs\_or\_sc})_i + \beta_5*(\text{adult\_coll})_i + \beta_6*(\text{med\_inc000})_i + \beta_7*(\text{rural})_i + \beta_8*(\text{ppe000})_{it} + \Sigma_{i=1}^{170} d_i\alpha_i + \varepsilon_{it}$$

$$(\text{coll\_rate})_{it} = \beta_0 + \beta_1*(\text{rsp})_{it} + \beta_2*(\text{kees})_{it} + \beta_3*(\text{nonwhite})_{it} + \beta_4*(\text{adult\_hs\_or\_sc})_i + \beta_5*(\text{adult\_coll})_i + \beta_6*(\text{med\_inc000})_i + \beta_7*(\text{rural})_i + \beta_8*(\text{unemp\_rate})_{it} + \beta_9*(\text{exp\_fut\_inc000})_t + \beta_{10}*(\text{med\_tuition000})_t + \beta_{11}*(\text{avg\_aid000})_t + \Sigma_{i=1}^{170} d_i\alpha_i + \varepsilon_{it,}$$

where *i* is a given school district, *t* is the year, d_i is a dummy variable for school district *i*, α_i is the fixed effect for district *i*, and ε is the error term.

Results

No Fixed Effects

The results of the simple linear regression models with no fixed effects are reported in Tables 4 and 5. Both models show significance for nearly every variable included. For reasons that are discussed later, this method of estimation is not appropriate and leads to biased coefficients.

The Robinson Scholars Program variable (rsp) appears significant in both models, negatively related to the high school graduation rate, and positively related to the college matriculation rate. The KEES program and the education level of the adult population are significant in both models and positively related to both the high school graduation rate and the college matriculation rate. The percent non-white high-schoolers in the district is significant in both models but changes from a negative relationship in the high school graduation model to a positive relationship in the college matriculation model.

Interestingly, median income comes out significant and negative in both models. The percent of the population that is rural is significant in both models but changes from a positive relationship in the high school graduation model to a negative relationship in the college matriculation model. The per-pupil expenditures variable in the high school graduation model is not significant. Expected future income is significant and negatively correlated with the college matriculation rate. The unemployment rate is significant and positively related to the college matriculation rate. Median tuition is weakly significant and negatively correlated with the college matriculation rate, and average financial aid is not significant.

TABLE 4: OLS Model of High School Graduation Rate, No Fixed Effects

Variable	Estimated Coefficient	Standard Error	t-statistic
rsp	-0.0195	0.0085	-2.31**
kees	0.0724	0.0093	7.80***
nonwhite	-0.1368	0.0334	-4.09***
adult_hs_or_sc	0.6541	0.0705	9.27***
adult_coll	0.8038	0.0779	10.32***
med_inc000	-0.0056	0.0007	-8.39***
rural	0.0243	0.0091	2.66***
ppe000	-0.0055	0.0039	-1.40
constant	0.4796	0.0420	11.42***
Adjusted R^2	0.1155		
F-statistic	28.50		

*Significant at the 0.10 level
**Significant at the 0.05 level
***Significant at the 0.01 level

TABLE 5: OLS Model of College Matriculation Rate, No Fixed Effects

Variable	Estimated Coefficient	Standard Error	t-statistic
rsp	0.0291	0.0081	3.62***
kees	0.1400	0.0146	9.56***
nonwhite	0.0778	0.0295	2.64***
adult_hs_or_sc	0.2444	0.0642	3.80***
adult_coll	1.1876	0.0716	16.58***
med_inc000	-0.0033	0.0006	-5.12***
rural	-0.0260	0.0084	-3.11***
exp_fut_inc000	-0.0072	0.0016	-4.48***
unemp_rate	0.7086	0.1235	5.74***
med_tuition000	-0.0445	0.0263	-1.69*
avg_aid000	0.0213	0.0171	1.24
constant	0.4329	0.0462	9.38***
Adjusted R^2	0.4656		
F-statistic	149.5		

*Significant at the 0.10 level
**Significant at the 0.05 level
***Significant at the 0.01 level

Fixed Effects

Results for the two models estimated using fixed effects are reported in Table 6 and Table 7.

In each set of results, "rho" reports the fraction of variance explained by the unmeasured characteristics of the school districts (i.e. school district fixed effects). Over 60% of the variance in high school graduation rates is explained by school district fixed effects, and over 95% of the variance in college matriculation rates is explained by the school district fixed effects. "Corr(u_i, Xb)" is interpreted as the correlation between the unobserved characteristics of the school districts and the explanatory variables included in the model. This correlation is highly significant for both models. It is statistically different from zero. Thus, fixed effects should be included in the model, resulting in a better fit for the panel data set.

Omitting fixed effects from the model results in incorrect, biased coefficients. A quick review of the results of the fixed effect models makes it clear that drawing conclusions from the simple linear regression models presented above would be erroneous. The Robinson Scholars Program, for example, is no longer significant in either case. The same is true for the percent of high-schoolers in the district that are non-white. This variable is no longer significant in either of the fixed effects models.

The focus of the discussion, then, will be on the results presented in Table 6 and Table 7, as the fixed effects models are preferred to the simple linear regression models.

TABLE 6: Model of High School Graduation Rate with Fixed Effects

Variable	Estimated Coefficient	Standard Error	t-statistic
rsp	0.0059	0.0089	0.66
kees	0.0507	0.0078	6.52***
nonwhite	0.0988	0.0858	1.15
adult_hs_or_sc	0.5728	0.1592	3.60***
adult_coll	0.6575	0.1846	3.56***
med_inc000	-0.0054	0.0016	-3.44***
rural	-0.1420	0.4519	-0.31
ppe000	0.0051	0.0046	1.12
constant	0.7202	0.2597	2.77***
corr(u_i, Xb)	-0.5378	0.0243	-22.13***
rho	0.6037		

*Significant at the 0.10 level
**Significant at the 0.05 level
***Significant at the 0.01 level

TABLE 7: Model of College Matriculation Rate with Fixed Effects

Variable	Estimated Coefficient	Standard Error	t-statistic
rsp	-0.0004	0.0089	-0.04
kees	0.0709	0.0111	6.38***
nonwhite	-0.0203	0.0764	-0.27
adult_hs_or_sc	-0.0484	0.1258	-0.39
adult_coll	0.5835	0.1465	3.98***
med_inc000	-0.0000	0.0013	-0.03
rural	0.7189	0.3160	2.27**
unemp_rate	0.1215	0.1216	1.00
exp_fut_inc000	-0.0023	0.0012	-1.87*
med_tuition000	-0.0323	0.0193	-1.67*
avg_aid000	0.0214	0.0126	1.70*
corr(u_i, Xb)	-0.9584	0.0231	-41.49***
rho	0.9592		

*Significant at the 0.10 level
**Significant at the 0.05 level
***Significant at the 0.01 level

Discussion

High School Graduation Model

Four explanatory variables in the high school graduation model are significant: KEES, percentage of adult population with a high school diploma or some college, percentage of adult population with at least a bachelor degree, and the median family income in the school district. Both the KEES program and the level of education of the adult population are positively correlated with the high school graduation rate. When the percentage of twelfth-graders receiving a KEES bonus award increases by 10%, the district high school graduation rate increases on average by 0.51% all else constant. Similarly, when the percent of the adult population with at lease a bachelor degree increases by 10%, the high school graduation rate increases on average by 6.58% *ceteris paribus*.

Surprisingly, the sign on the income variable is negative. For every $1,000 increase in median income in the school district, the high school graduation rate decreases on average by 0.54%, all else equal. This is surprising given that income is almost always positively correlated with educational attainment (see Haveman and Wolfe, 1995).

The coefficient on nonwhite is not significant, providing evidence that the percentage of non-white high-schoolers in a school district has no effect on high school graduation rates after controlling for the ability within the school district, the education level of the adult population, and income. The percentage of the population that is rural is highly insignificant, as are district per pupil expenditures.

As noted above, the Robinson Scholars Program dummy variable is not significant. This model provides no evidence that the Robinson Scholars Program has had an effect on high school graduation rates in the service area. This result is not due to the fact that the Program is small, per se, because a small effect could still be detected in the aggregate if the Program affected the districts in which it exists.

The KEES program, however, does have an effect. Some may argue that the KEES program is having an effect because it is "cream skimming". That is, the program targets students who are of high ability already since its provision is based on GPA and ACT score. While this may be the case, the highly significant coefficient on the KEES variable shows that the program is having an effect, even if it is only for high ability students.

The highly significant correlation value of -0.5378 suggests that the unobserved characteristics of the school districts are working in the opposite direction as the observed characteristics controlled for in the model. One can only imagine what these unobserved characteristics are. It may be, for instance, teacher quality. Perhaps teacher quality is low, and is thus working to decrease the expected high school graduation rate. It may also be unobservable cultural factors that are not included as controls in the model. This makes clear that individual level data that can control for more of these unobserved, negative factors would be desirable.

College Matriculation Model

Once again, the KEES program is highly significant and positively correlated with the college matriculation rate. When the percentage of twelfth-graders receiving a

KEES bonus award increases by 10%, the district college matriculation rate increases on average by 0.71% all else constant. The percentage of adults with at least a bachelor degree is also significant and positively correlated with the college matriculation rate. When the percentage of the adult population with at least a bachelor degree increases by 10%, the college matriculation rate increases on average by 5.84% *ceteris paribus*. The coefficient on the adult_hs_or_sc variable is not significant. Thus, the percentage of the adult population with only a high school degree does not affect college-going behavior. This result is not surprising, as children's educational attainment is often similar to that of their parents.

Income in this model is not significant, another surprising result since income is typically correlated with educational attainment. Once again, the percentage of nonwhite high-schoolers in the district has no effect when controlling for other factors. The percent of the population that is rural is significant at the 0.05 level and positively related to the college matriculation rate. Taken together, economic factors (unemployment rate, expected future income, median tuition, and average aid) are only weakly significant at the 0.10 level ($p = 0.0954$).

The variable of interest, rsp, is once again not significant. There is no evidence that the Robinson Scholars Program has had an effect on college matriculation rates in the service area. Perhaps the Scholars are not having a peer effect because they are only in classes with students who would otherwise be college bound. It may be that these students would have gone to college even without having Robinson Scholars in their classes to act as role models. Then the Program would appear to have no effect. On the

other hand, students who are not college bound are not exposed to Robinson Scholars and, therefore, do not experience a peer effect which could increase their college-going rate.

The correlation value in this model is also highly significant and negative, -0.9584. The unobserved characteristics of the school districts are working to decrease the expected college matriculation rate. Again, one can only venture a guess as to what factors are causing this outcome without individual level, carefully measured data.

Conclusions

The results of this study are both promising and worrisome for policymakers. On the one hand, the KEES program (a policy variable) is having a significant effect on high school graduation and college matriculation rates across Kentucky.[1] On the other hand, the other factors that affect high school graduation and college matriculation rates such as income, the education level of the adult population, and the percentage of the population that is rural are not easily manipulated by policymakers.

The results of this study also do not provide evidence that the Robinson Scholars Program has had any effect on high school graduation and college matriculation rates in the service area. While the Program may be important for a small number of individual students in determining educational attainment, it is not having a spillover effect in the aggregate. There are several possibilities as to why a Robinson Scholars Program effect is not detected here. As mentioned above, perhaps Robinson Scholars are in class with students who would have graduated and enrolled in college even without of the positive

[1] There is some controversy surrounding the program, however, due to the fact that it is financed through the lottery, on which the poor spend a greater share of their income.

peer effect of the Scholars. Then high school graduation and college matriculation rates would not be affected.

Perhaps omitted variable bias is canceling out any effect that the Program might be having. These omitted variables (i.e. parental encouragement, teacher encouragement, cultural impediments, the true price of college, etc.) could be more carefully controlled for in a model that used individual level data, resulting in unbiased coefficients and perhaps discerning a Robinson Scholars Program effect.

The use of aggregate data in this study was based on data availability. Using a data set that included individual characteristics was not feasible. Model estimation of an individual's decision to graduate high school or to go to college has much more explanatory power than the model presented here. The data requirements in this case, however, are extraordinary. The Program is currently in the process of carrying out a study that uses a treatment and control group and individual-level data to determine the outcomes of the Program. Such a data set can be much more detailed and can include many more factors that affect a student's educational attainment decisions. The longitudinal study will follow a cohort of students and compare the educational attainment of Robinson Scholars to that of their peers.

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